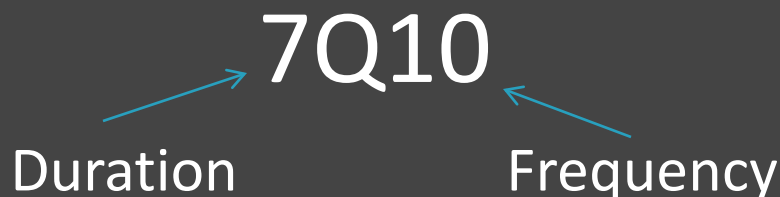


Deriving the Critical Low Flow for Permitting Numeric Nutrient Criteria

- Duration & frequency integral parts of the critical low flow:
- For toxics, 7Q10 commonly used: lowest average 7 consecutive day low flow, occurring with an average recurrence frequency of once in ten years



For nutrients, went back to the drawing board to evaluate duration and frequency to assure basis would be correct

Deriving the Critical Low Flow for Permitting Numeric Nutrient Criteria

- Basis found in EPA (1985)* and in the TSD (EPA, 1991)
 - 7Q10 was found to be a rough hydrologic surrogate for the biologically based 4 day, once in three years recommendation from EPA (1985)
- EPA (1985) clear about the recovery period of aquatic life after a chronic exceedence:

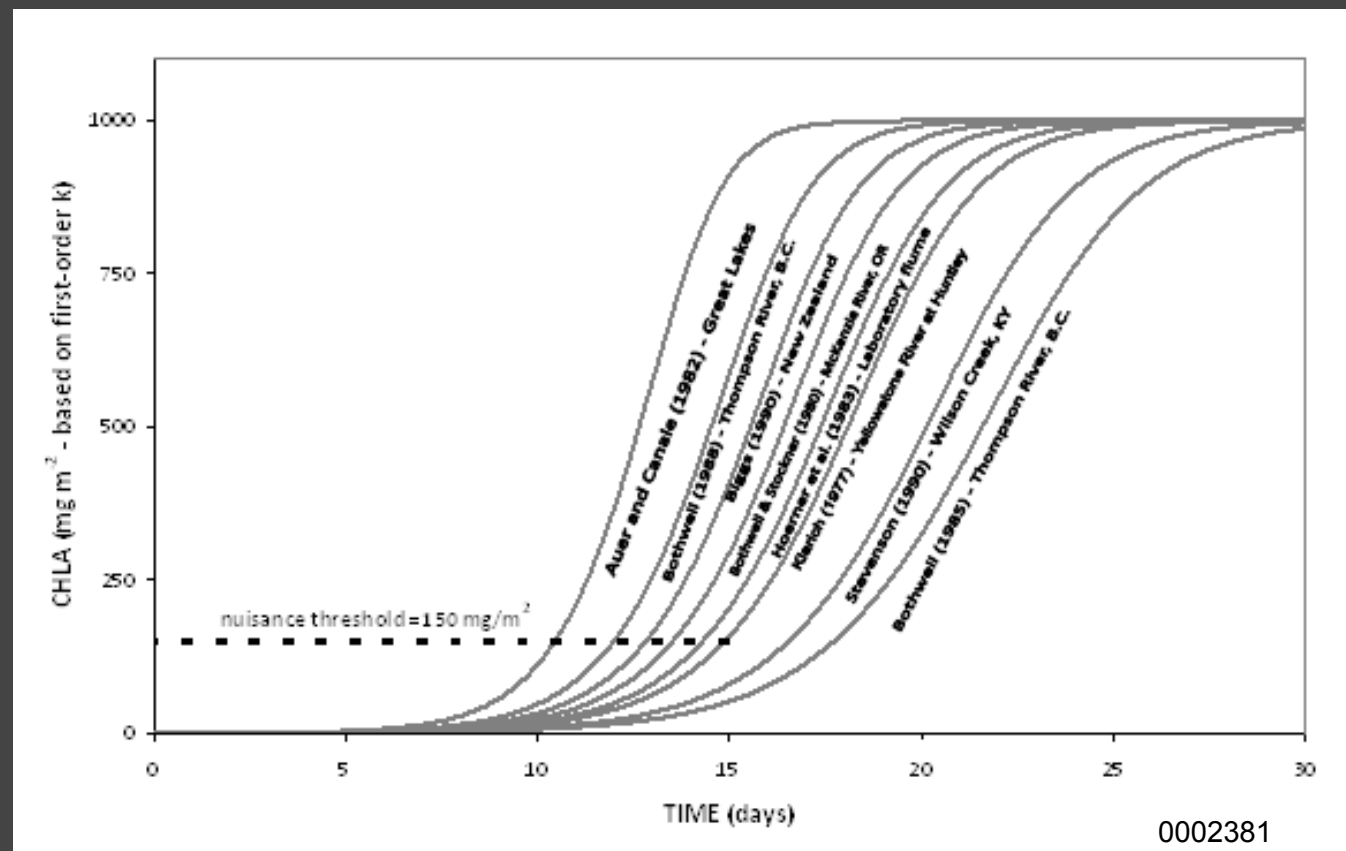
“Most aquatic ecosystems can probably recover from most exceedences in about three years. Therefore, it does not seem reasonable to purposely design for stress above that caused by the CCC to occur more than once in every three years, on the average, just as it does not seem reasonable to require that these kind of stresses only occur once in every five or ten years on the average.”

*EPA, 1985. *Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses*

Deriving the Critical Low Flow for Permitting Numeric Nutrient Criteria — Duration

- 150 mg Chl_a/m² is a thresholds for aesthetic impacts as well as aquatic life impacts (links via DO, etc.)

Benthic algae growth rates (K, day⁻¹) compiled from the literature, normalized to 20 C, and modeled



ALSO: In DEQ's stream dosing study, peak algal biomass occurred ≤ 20 days after dosing started

Deriving the Critical Low Flow for Permitting Numeric Nutrient Criteria—Duration

- Based on modeling of literature values and first-hand experience with the nutrient dosing study, MT DEQ believes that a duration of about 14 days is the appropriate duration to prevent stream algae from reaching 150 mg Chl a /m²
 - Durations longer than this would lead to the development of benthic algae growth beyond the desired level

Deriving the Critical Low Flow for Permitting Numeric Nutrient Criteria—Frequency

“Most aquatic ecosystems can probably recover from most exceedences in about three years. Therefore, it does not seem reasonable to purposely design for stress above that caused by the CCC to occur more than once in every three years, on the average, just as it does not seem reasonable to require that these kind of stresses only occur once in every five or ten years on the average.”

- MT DEQ selected a recurrence frequency of 5 years, because:
 - Slightly lower flow than the 3 year reoccurrence interval, thus somewhat more protective
 - 14 day, 5 year reoccurrence for season flows (July-Oct) routinely reported by USGS — readily available to Permitting

Thank You



Box Elder Creek Aug 29, 2010, 20 days after N and P dosing was initiated⁰⁰⁰²³⁸⁴